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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Rock Crushing
and Screening
Lubrication Features

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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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Rock Crushing and Screening

Lubrication Features

QUARRYING, crushing and screening of rock products is a major industry. It came into its own with the extension of our modern system of highways and the need for huge volumes of rock products for construction purposes.

Quarrying has been practiced since the Romans built their famous roads and aqueducts; stone-cutting since the days of antiquity. But neither one was a coordinated industry, nor did either one lead to the development of machinery when we entered the so-called machine age. The quarry-man adopted existing devices which had been developed more specifically for mining. Builders of crushers, pulverizers and screens, however, were not content to borrow. They studied ways and means of perfecting crushing and grinding machinery according to the type of rock to be handled in order to obtain the maximum output at minimum cost for operation. They realized the importance of lubrication and the rock products industry profited accordingly.

Rock crushing and screening machinery as required in stone quarry and cement mill service is heavy duty machinery. Accordingly, the bearings, gears and vibrating mechanisms are rugged, and must withstand the shock loading which may be off and on, speaking literally, due to the way in which the machines are built to operate. The jaw crusher — the "grizzly" in the service — is typical. Furthermore, these loads will vary according to the hardness of the rock. Bluestone or trap rock are among the harder types which must be reduced in size for road-building or railway ballast purposes.

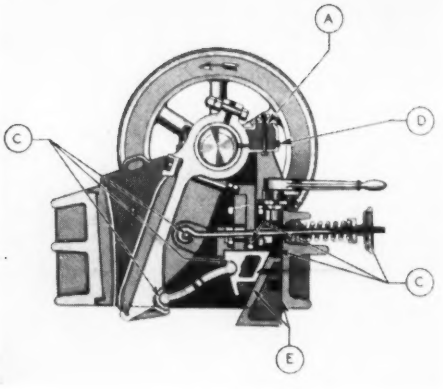
During this entire process of reduction in size there is naturally a lot of dust produced. In outdoor service this may not be much of a factor as a contaminant of the lubricants when the wind is right. Under cover, however, as in a cement plant, a walk through the mill will indicate how much dust can accumulate.

With the idea of protecting the moving parts of rock products machinery against the abrasive effects of this dust, the builders of lubricating equipment in turn studied the lubrication requirements of these heavy duty machines along with the operating conditions. Then, in conjunction with the designers the bearings, gears, seals, housings and means of lubricant application were perfected.

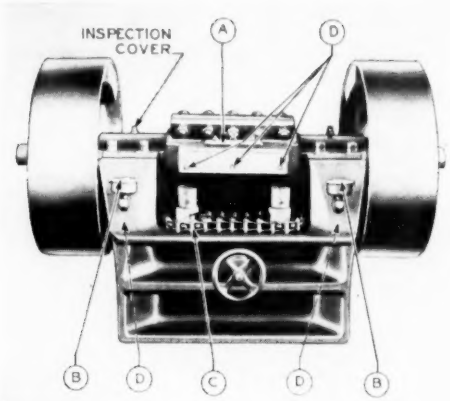
The results of these studies are noteworthy. A type of heavy duty machinery was produced which is distinctive for its utilization of means of automatic lubrication and the protection afforded the moving parts in the presence of abrasives which otherwise would quickly ruin a set of bearings or gear teeth.

SEQUENCE OF OPERATION

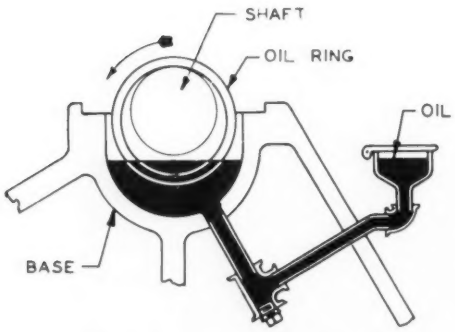
Handling of rock products requires machinery capable of crushing and grinding to successively finer materials. Essentially two distinctive types of operation are involved. The raw product must first be crushed on heavy duty machinery, after which grinding and pulverization to accurately graded sizes is usually necessary. The jaw crusher, gyratory or heavy roll crusher does the primary reducing; roll, ball or tube mills are used for secondary or final reduction where accurately controlled fineness is required. Grading involves a third step in the separation of the fines by means of screens.



Cross Section View.

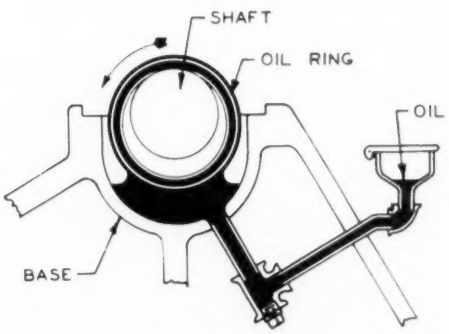


Back View.



Oil level when crusher is standing still.

Courtesy of Iowa Manufacturing Company.



Oil level when crusher is in operation. Note: Quantity of oil on oil rings causes oil level in oil cup to drop, do not fill oil cup as long as oil can be seen in it.

Figure 1 — Details of a Cedarapids Jaw Crusher with bronze bearings. A — shows pitman bearings; B — The side bearings; C and E — The adjusting mechanism, D — The drain plug.

OPERATING CONDITIONS

In service these functions must be carried on with the bearings, gears and eccentrics subject to

Pressure — due to heavy shock loads.

Moisture — due to humidity or even rain or snow.

Rock Dust — which is always abrasive.

Temperature Change — due to variations in atmospheric conditions.

METHODS OF LUBRICATION

Four broad classifications are involved in lubrication, i. e.,

Oil Circulation on the gyratories.

Centralized pressure grease lubrication on certain types of crushers.

Unit lubrication by pressure grease gun, oil can or waste packed bearings.

Bath lubrication on enclosed or partly enclosed gearing.

Hand lubrication on exposed gears.

PRIMARY CRUSHING OR BREAKING

A primary breaker takes rock as blasted from the quarry reducing the size sufficiently to permit of secondary treatment where necessary. The jaw crusher is of this type.

THE JAW CRUSHER

Jaw crusher design requires a hollow rectangular frame with a renewable breaking plate or die fixed at one end; opposing this is a lever or swinging jaw to which is attached a similar breaking plate. The fixed die is vertical — the swinging jaw being set at an angle and arranged to swing alternately back and forth. In this way crushing pressure is applied to the rock which is fed into the space between the breaking plates. Thus, a large lump of rock introduced at the top of the opening gradually is made smaller and smaller by the repeated blows of the swinging jaw until the pieces are small enough to drop through the discharge opening.

The swinging jaw is actuated by a link arrangement known as the pitman which is suspended

from bearings integral with the frame and located about midway between the swinging jaw and the rear of the frame. The pitman is capable of vertical rolling motion developed by the turning of its eccentric shaft. This motion is transferred horizontally to the swinging jaw by the toggle action of two flat plates which are held by knuckle joints to the back of the swinging jaw, the pitman and the lower part of the frame. The weight of the swinging jaw keeps this toggle mechanism in proper position. The nature of the service classifies the jaw crusher as heavy duty machinery. It is built accordingly.

Bearing Design and Lubrication

On this crusher, sleeve or roller bearings are used to good advantage due to their ability to carry heavy loads with evenly distributed pressure, and the facility with which replacement can be made if necessary. These bearings are provided for oil lubrication, or pressure grease lubrication and water cooling. The latter is very helpful as the pitman bearing, in particular, will tend to overheat.

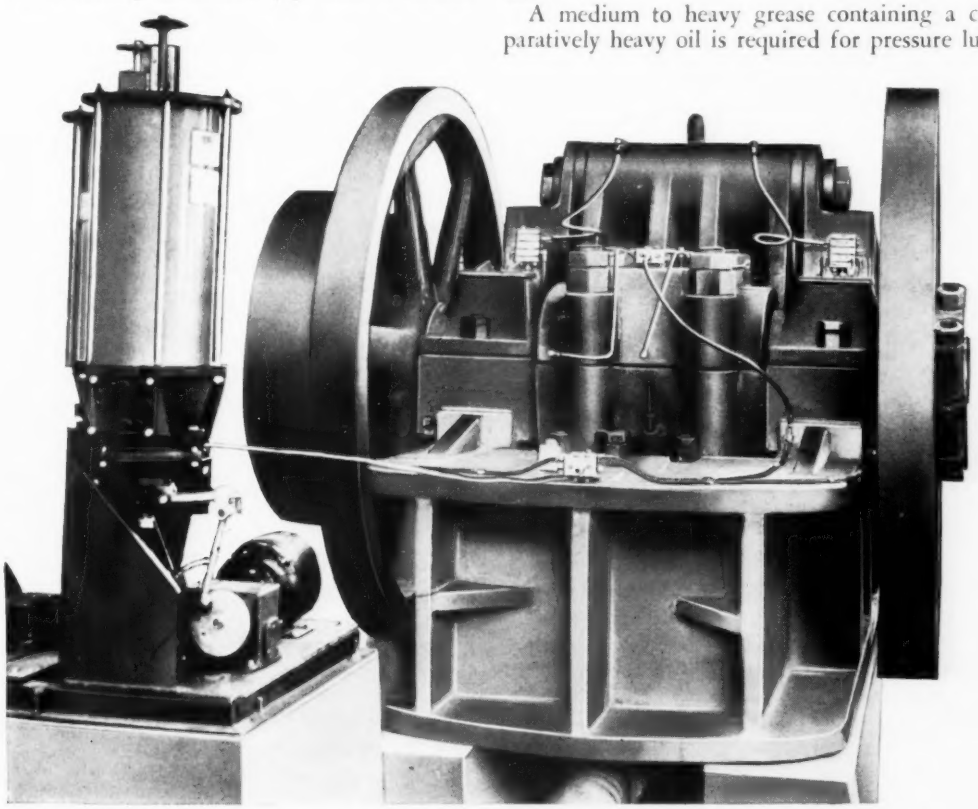
Lubrication of pitman and eccentric shaft bearings is assisted by certain features of design, i.e. (1) water-cooling as stated; (2) links or coiled springs to relieve the pitman bearing of some of its load; and (3) grease seals and flexible dust guards to reduce the extent of contamination of the lubricant and enable maintenance of pressure on the lubricating film by retarding leakage. This is especially important in the lubrication of heavy duty machinery where lubrication under pressure must be depended upon to partially counteract the mechanical pressure developed by the moving parts during operation.

Factors Affecting Lubrication

Crusher construction must always be carefully studied by the lubrication engineer. Final decision as to any lubricant should only be made after consideration of the probable loads developed at the bearings and the means available to provide lubrication at the points of maximum pressure to counteract these loads. Constant pressure on the lubricant is definitely advantageous in this regard.

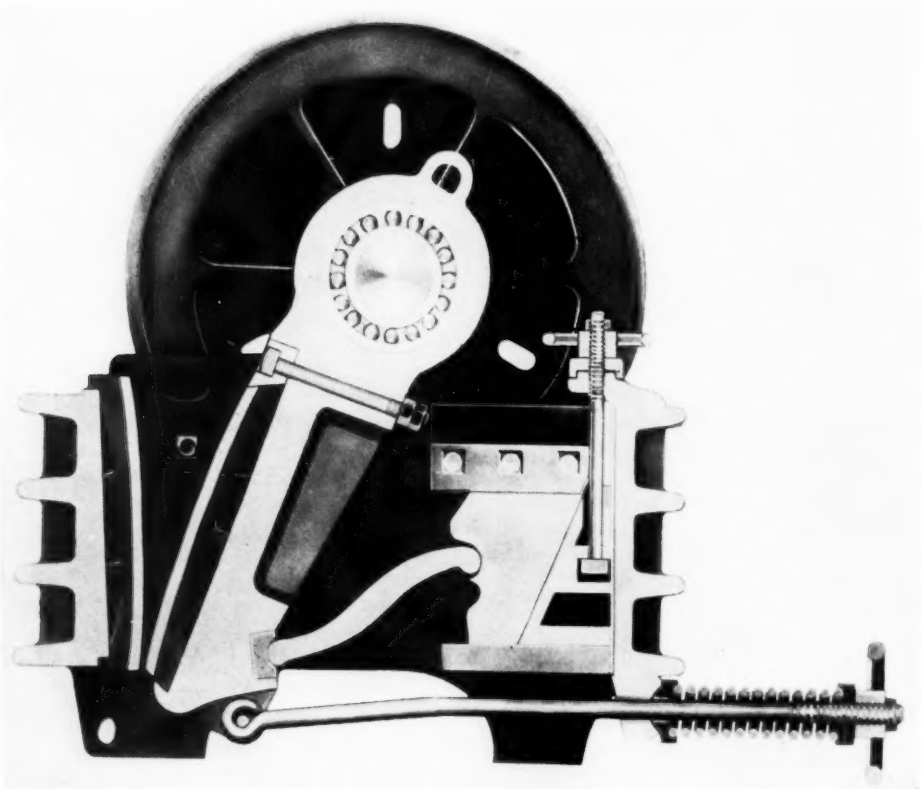
Grease lubrication is preferred by many due to the ease with which it can be applied either by a pressure lubricator or by means of a reservoir provided with a wool yarn or pad retainer which will insure positive lubrication without too much loss.

A medium to heavy grease containing a comparatively heavy oil is required for pressure lubri-



Courtesy of Traylor Engineering & Manufacturing Co.

Figure 2 — A Traylor type H Jaw Crusher equipped with automatic grease lubrication system.



Courtesy of The Universal Engineering Corp. Div. of Pettibone Mulliken Corp.

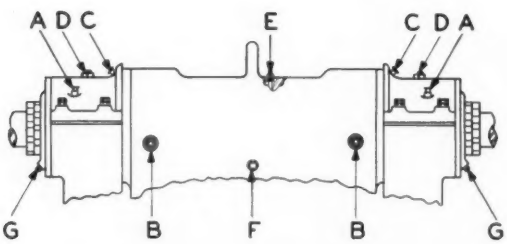


Figure 3 — Phantom showing pitman bearing of a Universal Jaw Crusher and lubrication instruction chart. A — shows the side bearings, 2 grease fittings; B — The pitman bearings, 2 fittings; C — End thrust lubrication, 2 fittings; D — Pipe plugs; E — Pitman flushing hole plug; F and G — Drain plugs for pitman and side bearings.

cation of these bearings. Pad lubrication, however, is more dependable when a lighter product is used which is sufficiently fluid to penetrate readily through the wool yarn or pad. A metal screen placed in the bottom of the reservoir will prevent strands of wool from working into the bearing clearance.

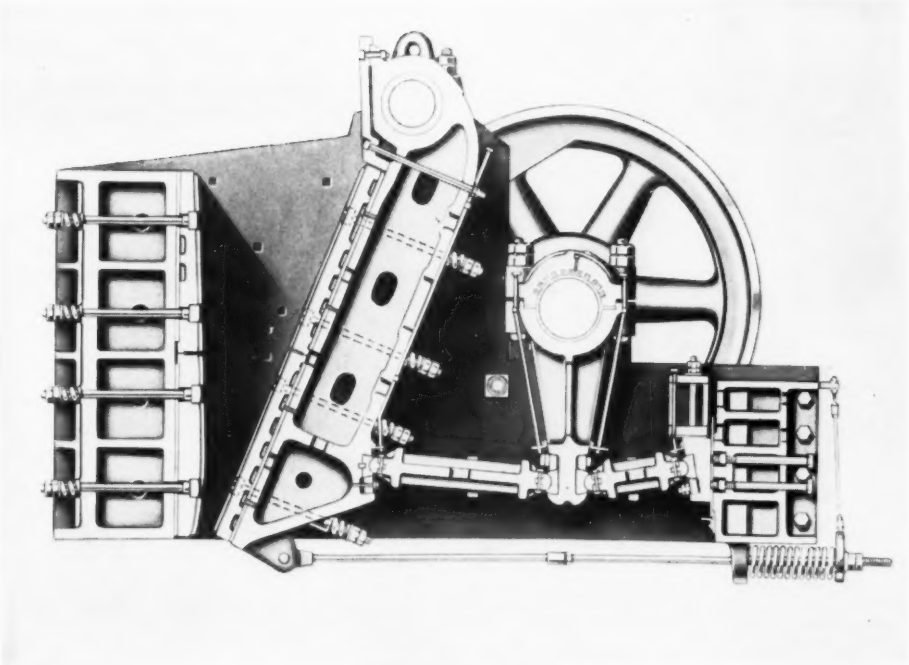
To assure of protection, the lubricant must completely fill the clearance spaces at all times, and be sufficiently plastic to resist being squeezed out from the high pressure zone regardless of the means of application. Some crusher builders who design for pressure lubrication make sure of this by providing pressure gun inlets at two points.

Loads on eccentric bearings are often comparable with loads on the pitman bearings. This will be especially true if the weight of the pitman is not balanced by springs, in which case the full weight will be exerted upon the eccentric bearings.

Lubrication of toggle seats also is dependent upon design. As rolling motion is developed, the duty imposed upon the lubricant is less severe. Some sliding motion will always prevail, however, so these mechanisms should not be overlooked. Usually a relatively heavy oil will suffice, being applied by sight feed oil cups.

THE GYRATORY

The gyratory also takes quarried rock for direct reduction in size. This machine crushes through the circular rolling motion of the crushing head, which is operated by gearing or belt drive through an eccentric at the bottom of the shaft. During the circular rolling motion of the head it successively approaches every point of the interior of the throat to develop a continuous breaking of the material to be reduced in size.



Courtesy of Allis-Chalmers Manufacturing Company.

Figure 4 — Details of the A-C "A-1" Jaw Crusher which is equipped for automatic pressure lubrication. Motor driven pump furnishes filtered oil to crusher eccentric shaft and swing jaw bearings. Only toggle ends and seats are manually lubricated.

Typical Features of Design

Group 1.
Crushers having short eccentric operated by bevel gears. Lubrication: bath, splash or circulation oiling.

Group 2.
(a) Crushers having long eccentric operated by bevel gears.
(b) Crushers with short eccentric, driven direct, no gears. Lubrication by circulation oiling.

Group 3.
Crushers with short eccentric driven by bevel gears: short shafts. Heavy-duty oil circulation system.

Design Affects Lubrication of Some Bearings

Lubrication of gear type gyratories with countershafts must be carefully studied, especially when the countershafts are fitted with outboard bearings to steady the shafts and reduce the load on the main bearings.

The Bearing Oil

The grade of oil to use will depend upon the design. A heavy engine or machine oil ranging from 500 to 750 seconds Saybolt Universal viscosity at 100° F. will afford adequate protection on some gyratories. Others require a turbine grade 300 second oil for their circulating systems.

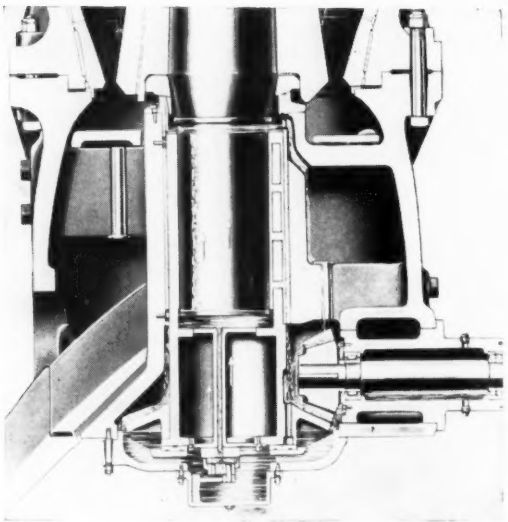
Climatic conditions, of course, must always be considered in selecting the oil. A lower viscosity is generally best in cold weather since the accompanying pour test assures of better fluidity under these conditions.

Gear Requirements

Realizing that the gearing in the gear-driven gyratory is subject to severe service, provisions are made to protect gears against contact with abrasive foreign matter. They are housed in oil-tight cases and dust rings are fitted on each shaft where it enters the gear case.

Even so some contamination of the gear lubricant will occur. For this reason, gear lubrication has been carefully studied. The lubricant must not be too thin or too low in viscosity otherwise its protective or cushioning ability may be inadequate to prevent the teeth from actual contact under heavy loads. Too heavy a lubricant, however, would hold any grit or dust in suspension and permit it to develop a scoring action on the gear teeth.

A gear lubricant of from 50 to 160 seconds Saybolt Viscosity at 210 degrees Fahr. having extreme pressure characteristics will usually be



Courtesy of Allis-Chalmers Manufacturing Company.

Figure 5 — Section through a Superior McCully Gyratory Crusher showing internal lubricating system. The reversible oil pump provides the necessary lubrication for the eccentric bearings, gears and brass wearing ring supporting the eccentric.

most dependable. An oil within this viscosity range (according to the operating temperatures) will resist the drying action of dust and prevent its packing between the teeth of the gears, thus obviating any tendency in the latter to spring and throw any unnecessary pressure on the countershaft bearings or eccentric. In cold weather a gear lubricant just like a bearing oil should have low pour test so that it will flow dependably. Mild extreme pressure characteristics are advisable when such a lubricant is to function under very heavy duty service.

Lubricating the Eccentric

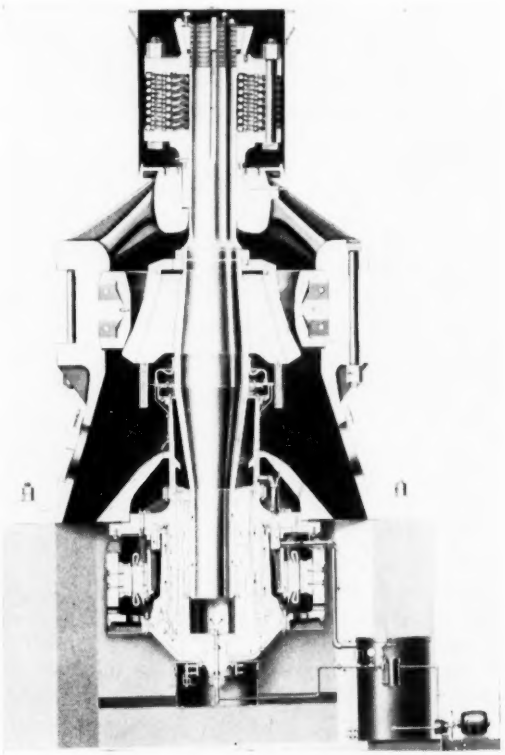
Gyratory motion for the main shaft is developed by the eccentric. This motion must be maintained at a uniform rate so that maximum crushing ability will be developed with minimum power consumption. Lubrication must, therefore, be most carefully studied. As the eccentric revolves in a bushing and around a shaft there are two surfaces to be lubricated. In addition, there is the brass wearing ring which carries the weight of the bevel gear and eccentric. In some machines, the base is also designed to fit loosely in the eccentric to enable tipping from side to side. As all the pressure will be periodically imposed upon a comparatively small area near the top of the thickest part of the eccentric sleeve, tipping may lead to serious overheating and wear unless adequate lubrication is maintained.

Automatic lubrication by oil delivered under constant and positive pressure to the mechanisms in question usually solves the problem. Fluid lubrication of this type is distinctly advantageous in that not only does the oil serve as a lubricant but also, to some extent, as a coolant to remove heat. Furthermore, the pressure under which it is circulated also tends to counteract somewhat the mechanical pressure developed when the gyratory is in operation.

The Lubricating System

Oil circulation is maintained by means of an oil pump located at the base of the crusher either within or adjacent to the oil reservoir in the bottom plate. An ample supply of oil is contained in the system, which, as a rule includes a suitable filter or strainer through which the oil is continually passed. This together with the general dust-proof construction insures against entry and circulation of an excess of abrasive matter through the system. All the lower moving parts are served with a flood of clean, cool oil while the crusher is operating, for the oil pump starts simultaneously with the latter and operates at a predetermined speed according to the speed or rate of crushing of the gyratory.

Where no oil pressure is provided, the rotation induces oil circulation by capillary attraction, the oil passing up through the clearance space around



Courtesy of Kennedy-Van Saun Mfg. & Eng. Corp.

Figure 6 — The Kennedy roller bearing gearless type "S" low head crusher showing features of the automatic oiling system.

the journal, over the brass wearing ring and back through passages to the reservoir below. This is a simple and expedient method of maintaining dependable lubrication provided fresh makeup oil is added regularly (as experience indicates) and provided the reservoir is drained and cleaned regularly to remove accumulations of foreign matter before it can do any damage.

Temperature Control

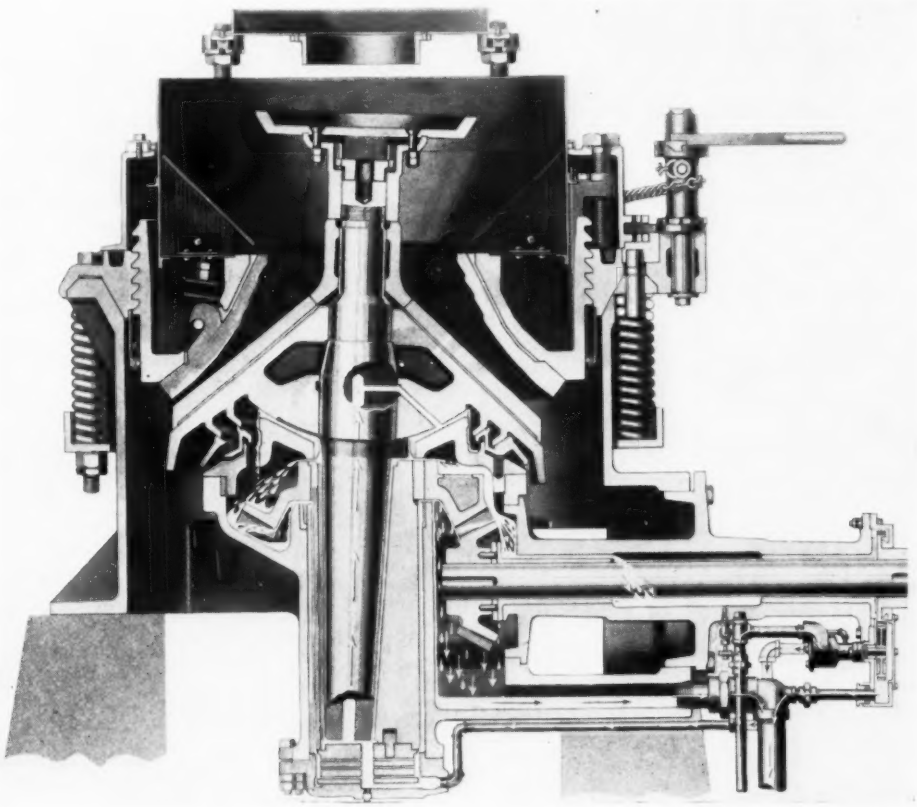
Suitable coils are installed in the base of the oil reservoir through which hot or cold water can be circulated according to the prevailing outdoor temperature. This enables oil temperature control. Warm or hot water circulation is especially helpful when starting in cold weather. It will decrease the frictional drag which would otherwise develop within the oil due to the increase in viscosity. Heating the oil in cold weather also reduces the load on the oil pump. In warm weather oil cooling is helpful, although under normal conditions of crushing, provided there is ample oil capacity, overheating will be unlikely, unless very hard rock is being handled.

Relation of Temperature to Oil Viscosity

The viscosity should be chosen with respect to the temperature. It should be in line with the manufacturer's recommendations. In cold weather an oil of lower viscosity is more dependable; conversely, for high temperatures use a heavier oil. Also consider the provisions for heat exchange, i.e. heating or cooling, and the temperature of the inlet water. Under extreme conditions, the operator should consult with his lubrication engineer.

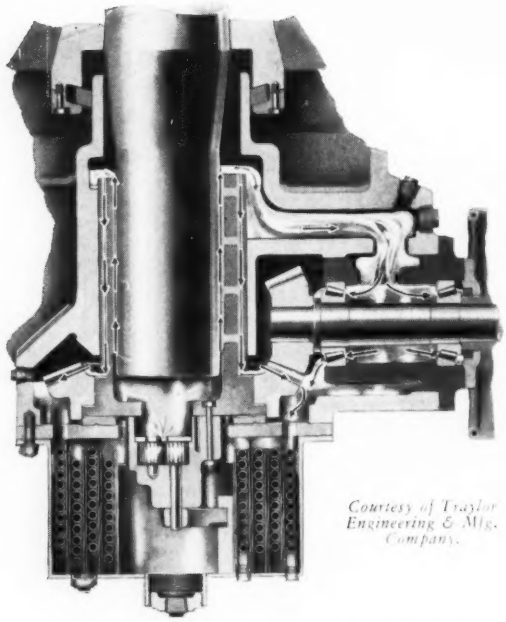
Suspension Rings

The top bearings along with the suspension rings are contained in a spider at the top of the main shaft. These must also be carefully lubricated using an oil of sufficient body or viscosity so that it will not run prematurely through the clearances. Usually a lubricant comparable in viscosity to a light cylinder oil will meet this requirement. To facilitate retention of oil the space within the cap can be packed with a pad of wool yarn saturated with oil. By keeping this well loosened and not allowing it to pack or mat, relubrication, by adding a few ounces of oil daily applied via the oil hole in



Courtesy of Nordberg Manufacturing Company.

Figure 7 — The Nordberg Symons Cone Crusher showing oiling system and flow of oil. This can be maintained by an integral oil pump (as shown) or by an independent oil pump.



Courtesy of Traylor Engineering & Mfg. Company.

Figure 8 — Lubrication and constructional details for a Traylor type TY crusher. Oil flow is shown by arrows.

the spider cap will suffice.

VERTICAL RING CRUSHING

Vertical ring machines crush over a vertical ring with crushing pressure developed through spring action, in contrast with the conventional gyratory which crushes on more or less of a horizontal anvil ring. The drive varies, in some vertical mills a steel anvil ring is supported and revolved by a large horizontal gear driven shaft. Hammer rolls are held against the inner surface of this ring by means of springs. In operation the material to be crushed is delivered to the point of crushing through a spout, being kept at the ring surface by centrifugal force.

Other types of vertical ring crushers are driven by direct connected motors or belt and pulley connections through the top hammer roll instead of the ring. The movement of the top roll causes the ring to revolve; this in turn actuates the lower rolls.

Lubrication Requirements

The bearings of the hammer rolls, ring shaft and pinion shaft along with the gears which comprise the drive all require careful lubrication. The hammer rolls are frequently mounted on roller bearings enclosed in dust-proof housings. These bearings operate normally in a bath of oil which is contained in, and circulated from the reservoir fixed to the end of the hammer roll shaft.

As this involves flood lubrication this oil should never be so heavy as to become sluggish and resistant to circulation. As a rule, a straight mineral oil having viscosity range of from 500 to 750 seconds Saybolt at 100 degrees Fahr. will meet normal requirements and carry the operating load satisfactorily.

Ring shaft bearings and the higher speed pinion shaft bearings if kept free from dust or other non-lubricating matter do not present any lubrication problem. Speeds and loads are normally well-balanced. Oil lubrication by means of oil-saturated wool yarn, or a light grease will give ample protection.

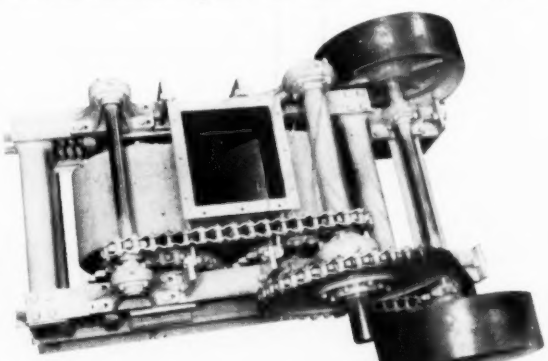
Gear lubrication also can be simplified by the means provided to prevent contamination of the lubricant. Oil-tight and dust-proof gear housings are well adapted to bath lubrication and the use of a light gear lubricant.

Ring crushers which are driven through the top roll require bearings on each of the hammer roll shafts. These are long and fitted with collars to exclude dust or grit. Each bearing is equipped with a large reservoir capable of holding a quantity of grease which is led in via grooves on the low pressure side. Usually an N.L.G.I. No. 1 grade will meet the requirements.

SECONDARY CRUSHING OR GRINDING

Secondary reducing units pulverize the rock after primary crushing. Ball, rod or compartment mills, or a cone crusher, which produce a final product of remarkably uniform fineness are classified as secondary crushers. Cement rock which must be ground just as finely before burning as after, is run through these machines.

The design involves a horizontal steel drum which is partially filled with steel balls or rods. As the drum is turned by a set of enclosed motor driven reduction gears the balls or rods roll con-



Courtesy of Diamond Iron Works Inc. & Mahr Manfg. Co. Div.

Figure 9 — Three-quarter top view of a Diamond roll crusher. Each bearing on this machine is equipped for individual pressure grease lubrication.

tinually to the bottom, grinding the particles of rock between and beneath them. Due to the loads involved, the bearings must be designed accordingly, being comparatively large, in order that the unit loads may not become excessive. In addition, lubrication must be maintained very often in an atmosphere of grit or dust. Naturally, therefore, due precaution is taken in design to keep this dust out of the bearings.

A fairly heavy lubricant is generally used. Fortunately, speeds are low, so there is no objection to a heavy lubricant from this angle. In other words, it is practicable to use a medium to heavy grease which will carry the prevailing loads satisfactorily and seal effectually against entry of abrasive dust.

Temperature Control

Overheated bearings may result from

(1) Entry of abrasive dust.
(2) Use of an unsuitable lubricant.
(3) Insufficient lubrication.
(4) Some mechanical fault such as misalignment or insufficient clearance.
(5) Transmitted heat as for example when grinding relatively hot materials.

Overheating should be corrected as soon as possible, even though this may require stopping the mill. Where it is not practicable, the troublesome bearing can be loosened, flooded with oil or subjected to external cooling by a fan. At the first opportunity the bearing should be examined to see that the grooves and lubricant feeds are clear and not clogged. If the temperature has risen sufficiently the bearing metal may have become soft enough to wipe.

Trunnion Bearings

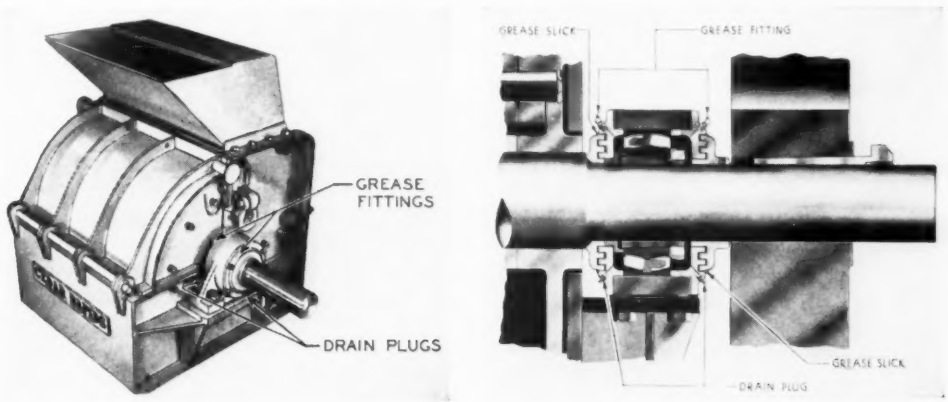
Trunnion bearings are comparatively large. In cement mill service in particular they are exposed to the possible entry of dust and grit and the probability of heat being transmitted to the bearings from the shell. Sometimes these bearings are lined on the bottom half only since the direction of load is always downward. This facilitates relining if the bearing metal becomes worn or unduly scored. In such cases, the bearing cap serves as a dust shield and if desired as a receptacle for the grease used in lubrication.

Grease for this type of service should be a carefully refined, fibrous product of high melting point. Wherever wool yarn packing is desired a lighter grease or a high grade mineral oil can be used. The wool yarn serves as a seal or strainer to prevent dust or dirt from getting to the bearing. Bearing temperatures can be controlled by cooling water circulation when the design will permit

Bearings Designed for Automatic Lubrication

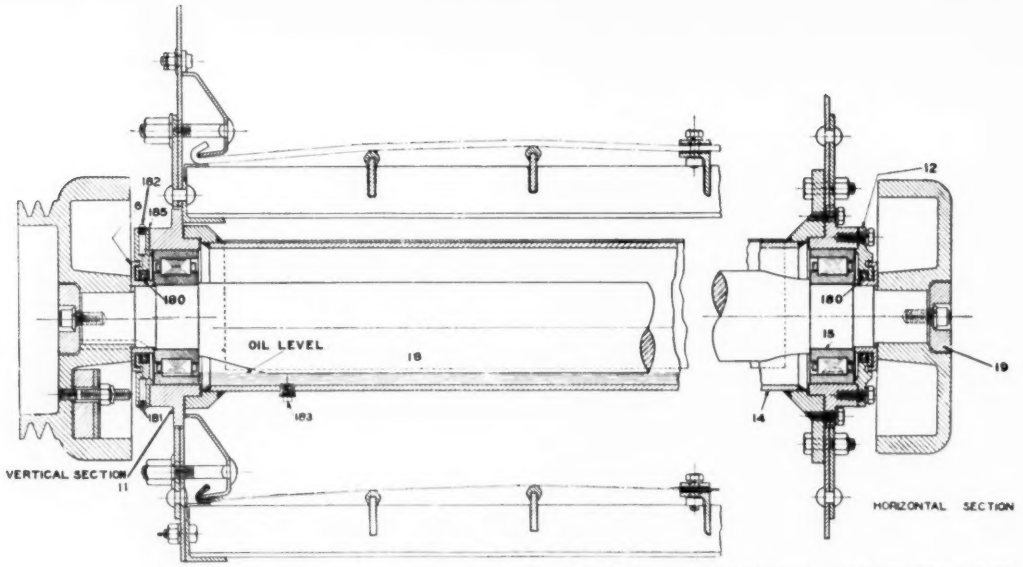
Bearings of the two-part type can also be designed for automatic lubrication. Here the cap as well as the bottom half is lined. Oil is carried in a suitable reservoir below the latter, being distributed by a dipper device which is rotated by the shaft. The usual construction provides for two of these dippers which at every rotation automatically fill themselves with oil to empty it along the top of the shaft. From this point, it is distributed throughout the clearance space.

When these bearings are water-cooled the temperature is so controlled that a medium to heavy viscosity oil will give ample protection. Bearings of this type keep out abrasive foreign matter as a rule. Furthermore, as they are flooded with oil any dust or dirt which may be present will be flushed down into the reservoir. Normally it will settle here and can be removed by draining at periodic intervals.



Courtesy of Iowa Mfg. Company.

Figure 10 — Details of a Cedarapids Hammermill showing bearing design and location of grease fittings and drains.



Courtesy of Allis-Chalmers Manufacturing Company.

Figure 11 — Section through an A-C Ripl-flo vibrating screen showing bearings and parts related to lubrication.

Roller bearings are also adaptable to trunnion service. They are regarded as being quite as advantageous as the self-oiling plain bearing even though the former may not have as ample a lubricant reservoir. Either oil or grease can be used according to the type of seal and the means of relubrication provided by the designer.

Ring oiled bearings are another type of self lubricated mechanism which can be applied to ball and tube mill machinery. They are well suited to pinion shafting. Such bearings are best served by a light-medium straight mineral oil of around 300 seconds Saybolt Viscosity at 100 degree Fahr.

Ring oilers should be cleaned at regular intervals. At the same time fresh oil should be added. Most troubles with ring oilers will be due to the reservoirs being too small to allow the oil to cool sufficiently, especially if relatively high bearing temperatures prevail. Under such conditions it may be practicable to increase the oil capacity by tapping a short length of pipe into the lower part with a cap on the lower end.

Wick feed oilers also are used. They are particularly suited to existing installations due to their low initial cost and the ease with which they can be applied. Wick oiling assures of positive lubrication and dependable operation. As it assists in reducing bearing wear, it contributes to lower maintenance and repair costs.

SCREENING AND SIZING

Rock products as they are delivered by the grinding and crushing machinery must be screened and sized to prepare them for subsequent usage. The size depends upon the use, i.e., one to two inches in diameter when the stone is to be used in concrete construction, down to very fine mesh when intended for the manufacture of cement. In between are the various grades of fine to medium sizes used for highway construction, railway ballast, etc.

Screens in this service are of rotary or vibrating type.

ROTARY SCREENS

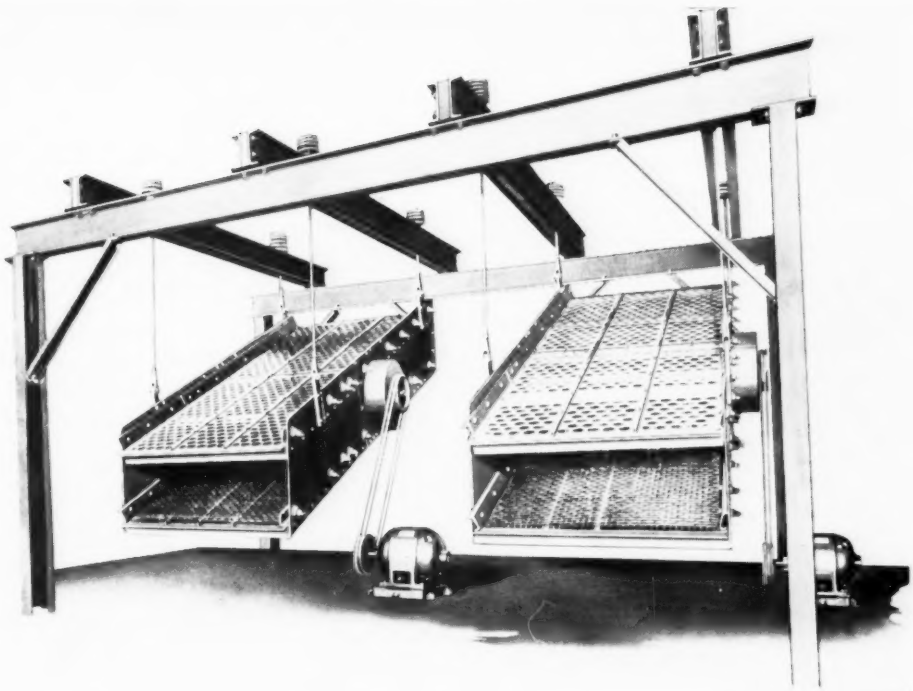
Rotary screens are carried usually on two points of support — one at each end. They are used in stone quarry service. A rotary screen consists of one or more cylinders or jackets composed of perforated plates. The screen is mounted on an angle so that as it rotates, the material travels along the plates falling through the perforations according to size.

Such a screen is driven or turned by gears usually of the bevel type. The pinion or driving element is keyed to a shaft which in turn is belt or chain-connected through a speed reducer to an electric motor.

Lubrication of Rotary Screen Gears

The driving gears of a rotary screen will frequently operate exposed, with their lubricants subjected to contamination by dust, dirt and probably moisture. Also in many cases they may be exposed to wide variations in temperature, which would likewise tend to reduce the efficiency of lubrication, unless the lubricant used has been specially refined to function and protect metallic surfaces under these conditions.

Gears can be best protected by a lubricant which will not only form a protective film to counteract the abrasive effect of dust, dirt, etc., but will function irrespective of temperature, moisture and



Courtesy of Link-Belt Co.

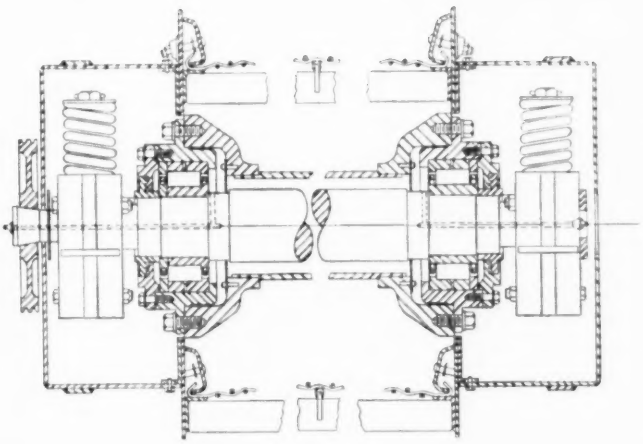


Figure 12 — A set of Link-Belt double deck "CA" cable suspended concentric action vibrating screens, also details of the vibrator unit which is designed for pressure grease lubrication.

weather conditions.

This is a broad requirement, one in fact that very few compounded lubricants or greases will meet with any degree of success. Experience has proven that a straight mineral residual product, cut back with a solvent to facilitate application will give very satisfactory results. Subsequently, the solvent evaporates to leave a protective film on the teeth comparable to that obtained from the base product.

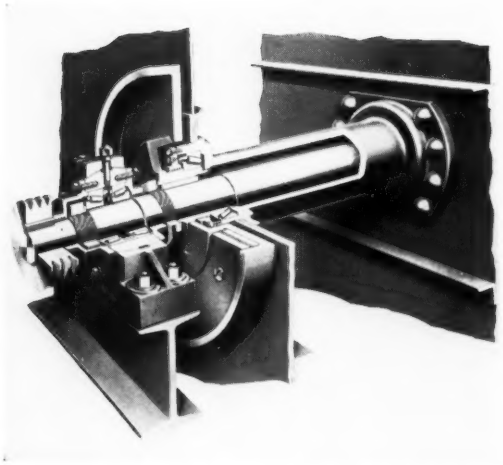
Where suitable protective housing is provided to prevent loss of lubricant through abnormal dripping, a viscosity of from 90 to 160 seconds Saybolt at 210 degrees Fahr. will usually serve the purpose. High temperature operation, however, may require a lubricant of higher viscosity ranging perhaps up to 5,000 seconds Saybolt when the gears are exposed.

Some types of heavier lubricants will tend to pick up dust, which will ultimately ball up and scale or be thrown off, leaving the teeth practically exposed. For this reason, the utmost care is necessary in choosing gear lubricants in order to make sure that they are refined to high lubricating and adhesive characteristics, which will render them capable of resisting the effects of centrifugal force under higher speed conditions.

Where it is possible to enclose such gears, the practice is very advisable. Not only will a housing prevent entry of foreign matter, but also it will serve as a means of protection for the operator as well as reducing the frequency of relubrication.

Rotary Screen Shaft Bearings

Shaft and support bearings may have to be lubricated under the same conditions although the housings, if properly designed and installed, will



Courtesy of Kennedy-Van Saun Mfg. & Eng. Corp.

Figure 13 — Screen shaft drive for a Kennedy-Type "A" vibrating screen. Roller bearings are a feature of this unit.

normally keep out a good deal of the dust and dirt. Plain babbitted bearings are widely used, with provision for grease lubrication by compression cup or grease gun. Under the prevalent operating conditions grease is probably a better lubricant than oil since it can maintain a more effective seal against entry of abrasive foreign matter. It should be a product of medium body or consistency, able to carry considerable load and resistant to water wash.

VIBRATING SCREENS

Vibrating screens classify crushed materials by the vibrating action of the frame which holds the screen fabric with respect to the products. Screens may be of the 2 bearing or 4 bearing type. The movement of the former is produced by the centrifugal force resulting from unbalanced weights. The movement of the 4 bearing screen is obtained by journaling the shaft at the inside bearings, eccentric in relation to the main or support bearings.

The pattern of movement of the vibrating screen deck may be (a) circular, (b) straightline, (c) elliptical. The type of motion has a certain relation to speed — for example a screen with $\frac{1}{8}$" movement would generally be operated in a speed range of 1800 to 2000 RPM; whereas one with $\frac{1}{4}$" movement will have a speed range of 1000 to 1200 RPM — the larger the movement the lower the speed. Where handling moderately sized or large size rock the larger movements are necessary to prevent the rock from becoming lodged in the openings. Screens with circular movement are set on an incline averaging about 20°. Screens with straightline or elliptical movements are generally set horizontal.

Lubrication

On a vibrating screen the bearings which carry the vibration producing mechanism are the only parts which require lubrication. In modern screen design these bearings are of the ball or roller type. Each bearing is individually lubricated. While it is possible to design for either oil or grease lubrication the majority of screens today are grease lubricated because grease can be more readily applied under most conditions.

A grease lubricated bearing does not need as complicated a seal as would an oil lubricated bearing, furthermore it more effectively prevents the entrance of dust and grit into the bearings. Some form of compression or pressure grease lubricating device is used to insure as nearly positive lubrication as possible. A medium bodied grease (N.L.G.I. No. 2) will be suited to such operations. Most bearings are greased before leaving the factory. This initial lubrication should be good for 2 to 3 weeks under normal operation, thereafter the bearings should be greased according to the conditions of service. The frequency of lubrication should be developed on the job in cooperation with the lubrication engineer. The normal cycle is from 2 to 3 weeks. A rise in bearing temperature during operation may develop in some cases — a rise of 40° F. is not abnormal.

Oil lubrication has its advantages when the bearing is sufficiently sealed to retain the oil inasmuch as there will be less possibility of frictional temperatures developing within an oil of the proper viscosity with respect to the speed than in the type of grease that is normally recommended. These bearings are relatively high speed and as such will function most dependably when their surfaces are lubricated by a lubricant which will develop the least amount of frictional load. A medium viscosity straight mineral turbine grade oil is recommended in this case.

CONCLUSION

Simplified plans for lubrication have been proposed for many types of machinery. The benefits to be derived by the consumer are marked when his machine design, operating conditions, and methods of purchase, storage and application of lubricants are coordinated. By this we mean a purchasing policy which considers the operating conditions, a management policy which considers the value of skilled lubricating personnel, and an engineering policy which realizes the trends towards automatic lubrication.

The Construction Industry has adopted most of these policies. The Rock Products Industry as an adjunct to construction is to be commended for its equal foresightedness. This article has discussed lubrication of rock products machinery and the suggestion of lubricants from a similar point of view.

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TEXACO LUBRICANTS FOR ROCK PRODUCTS

TEXACO LUBRICANTS FOR ROCK PRODUCTS MACHINERY

SIMPLIFIED PLAN

Texaco Lubricants Recommended for Indicated Temperatures

PART REQUIRING LUBRICATION	RELUBRICATION INTERVAL HOURS	CONSISTENTLY ABOVE 90° F.	LOWEST EXPECTED 32° F.	LOWEST EXPECTED 10° F.	LOWEST EXPECTED BELOW 10° F.
Gasoline and Diesel Engines	100	Texaco Ursa Oil X-40★★	Texaco Ursa Oil X-30★★	Texaco Ursa Oil X-20★★	Texaco Ursa Oil X-10★★
Gear Boxes Bearings (severe service) Chain Drives Flexible Couplings Universal Joints Other oil-lubricated parts in heavy duty service	1000 10 100 1000 1000 10	Texaco Meropa Lubricant-6 or Universal Gear Lubricant EP 140	Texaco Meropa Lubricant-3 or Universal Gear Lubricant EP 90	Texaco Meropa Lubricant-3 or Universal Gear Lubricant EP 90	Texaco Meropa Lubricant-1 or Universal Gear Lubricant EP 80
Hydraulic Mechanisms Air Cleaners Air Compressors Bearings (normal service) Electric Motors and Generators Other oil-lubricated parts in light duty service	1000 10 1000 10 1000 100	Texaco Regal Oil PE (R&O) or Texaco Algol Oil	Texaco Regal Oil PC (R&O) or Texaco Alcaid Oil	Texaco Regal Oil AZ (R&O) or Texaco Cetus Oil	Texaco Regal Oil AZ (R&O) or Texaco Spica Oil
Grease Fittings Plain Bearings *Track Rollers (sleeve type) and other frequently lubricated bearings working in mud and water	10 10 10	Texaco Marfak No. 1 or Texaco Track Roll Lubricant—Heavy	Texaco Marfak No. 0 or Texaco Track Roll Lubricant—Medium	Texaco Marfak No. 00 or Texaco Track Roll Lubricant—Medium	Texaco Track Roll Lubricant—Light
Hand Packed Bearings Wheel Bearings Roller Bearings Ball Bearings	100 1000 100 100	Texaco Marfak No. 2 Heavy Duty	Texaco Marfak No. 2 Heavy Duty	Texaco Marfak No. 2 Heavy Duty	Texaco Star Grease No. O (use Marfak No. 2 HD in Wheel Bearings)
Cables	10-100 As required	Texaco Crater A	Texaco Crater A	Texaco Crater A	Texaco Crater A
Exposed Gears	10-100 As required	Texaco Crater No. 5X or Texaco Crater 5X Fluid	Texaco Crater No. 2X or Texaco Crater 2X Fluid	Texaco Crater No. 1X or Texaco Crater 2X Fluid	Texaco Crater A

*Use Texaco Star Grease No. O in Allis-Chalmers track wheels which have roller bearings.

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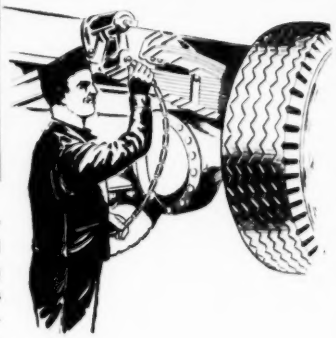

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